

# OVER-THE-AIR RE-PROGRAMMING METHOD OF RADIO TRANSCEIVERS

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention:

5       The present invention relates to radio transmitter/receivers and in particular it relates to a method of re-programming radio transmitter/receivers over-the-air (OTA).

### 2. Description of the Prior Art:

10       A radio transmitter/receiver (transceiver) such as a radiotelephone is designed for operation with particular types of networks such as GSM (global system for mobile communication) 900 or DCS (digital communication system) 1800. In GSM 900 and DCS 1800, radio waves of a 900  
15       megahertz band and an 1.8 gigahertz band are used respectively. Each of GSM 900 and DCS 1800 is a mobile communication system widely used in, for example, Europe.

Intended use of the radiotelephone with a particular network(s) in a restricted geographical area, however,  
20       requires that the telephone be configured so as properly to communicate with the particular network(s). The user of a radiotelephone will usually have a telephone which has been configured for communication with a so called "home network". The home network is the local network usually  
25       most used by the subscriber.

      The area within which a user of e.g. a GSM radiotelephone may operate, however, is considerable and is

not limited to the home network but may be extended on many other networks throughout the world. Use of a handset outside the home network is known as "roaming".

When the radiotelephone is to be used in roaming it is often necessary for it to have a configuration different to that for use with the home network. It is possible for re-configuration of radio transmitter/receivers to be effected by means of signals received across the air interface.

It is also convenient for the radio to be re-configurable over the air interface so as to support different types of communication and user applications e.g. addition of address book manager, whether or not it is located in the home network.

Over-the-air re-programming of radio receivers is well known in the art and reference may be made to US patent 5,381,138 for example. The capability to obtain programming data from a network is particularly useful for a roaming radio transmitter/receiver.

When beginning operation in an area for which the radiotelephone is not configured and it is required to download the data for reconfiguration from one of the available networks, a communication link must first be established with the network of interest. It has been

proposed that a pilot channel be established in all areas from which the roaming radiotelephone may obtain the data necessary for reconfiguration.

A pilot channel of this type, however, will require a relatively large bandwidth to allow a sufficiently fast transfer of the data required. Since the pilot channel is provided separately from a traffic channel used for

5 transferring voice data and a control channel for performing control operations inherent to the particular network, establishment of the pilot channel of a relatively large bandwidth lowers utility efficiency of the frequency resources in the whole network. Further, the task of  
10 standardization of the pilot channel of a relative large bandwidth for transferring a large amount of data is considered to be complicated.

#### SUMMARY OF THE INVENTION

The object of the present invention is to provide an  
15 over-the-air re-programming method of a radio transceiver which does not deteriorate the utility efficiency of the frequency resources of a network and can be easily standardized.

According to the invention there is provided a method  
20 of downloading re-programming data from a network for installation in a radio transmitter/receiver comprising initial communication from a first dedicated channel of relatively small bandwidth broadcasting at least the frequency and radio access parameters of a second channel  
25 of relatively large bandwidth from which re-programming data may be downloaded.

The above and other objects, features, and advantages of the present invention will become apparent from the following description referring to the accompanying drawings which illustrate examples of preferred embodiments of the present invention.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a flow diagram of a reconfiguration process in a preferred embodiment according to the present invention;

FIG. 2 illustrates a logical structure of a bootstrap channel; and

FIG. 3 is a flow diagram of an alternative reconfiguration process according to the present invention.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

A roaming radio transmitter/receiver (mobile) is located in a region served by one or more networks and the user of the mobile wishes to communicate with a network from which the user can obtain re-programming data and subsequently begin communicating with the network in the communication mode selected.

A pilot channel broadcast is maintained in the region and contained in the pilot channel broadcast there is at least sufficient information for the mobile to connect to a second channel which will be called the bootstrap channel.

Conveniently the pilot channel will be broadcast in all regions over a standardized radio interface. Only a small bandwidth is required for the pilot channel because of the

small amount of information contained in the broadcast.

The small bandwidth requirement makes the task of standardization much easier with respect to the pilot channel. The wider bandwidth channels are more  
5 conveniently assigned locally for ease of implementation.

The pilot channel (P\_CH) broadcasts a list of sets of parameters corresponding to networks available in the region. The mobile receives the network transmission through the pilot channel. If the existing configuration  
10 of the mobile is matched to the available regional radio schemes, then a second channel, that is, the bootstrap channel (B\_CH), is logically mapped onto the selected transmission mode. The base station and mobile exchange information over this dedicated logical channel.

15 The bootstrap channel is logically mapped on top of one of the default modes of the terminal; a mapping of a logical bootstrap channel onto the physical GSM channel for instance may be implemented. Once the mapping has been effected the terminal may download data from the base  
20 station. The bootstrap channels provided by each operator may accommodate differing services with regard to the applications available for downloading.

The flow diagram shown in FIG. 1 depicts a reconfiguration procedure.

25 When the mobile is switched on in step 101, it reads the pilot channel broadcast at step 102. The mobile must be configured to support the (standardized) radio interface

of the pilot channel. The pilot channel carries local radio parameters (standards supported in the regional environment in which the mobile is located).

After processing the received information, it is  
5 checked whether the radio scheme of the mobile is compliant with the environment or not at step 103. If the minimum resources required by its radio local environment are not available, then the processing is terminated at step 104. If the mobile has the minimum resources required by its  
10 local radio environment at step 105 the mobile communicates with the base station through the bootstrap channel. Prior to the change of channel, pilot channel (P\_CH) to bootstrap channel (B\_CH), a logical mapping of the bootstrap channel is performed within the mobile on the selected air  
15 interface at step 106.

When operation on a local bootstrap channel transmission has been established, the user may wish to change some properties or the performance of his mobile and can request supply of the desired services from the network.  
20 Here, it is determined whether the transmission mode application is to be changed or not at step 108. If no changes are required then the mobile adopts the default transmission mode in stand-by and releases the allocated bootstrap channel and the session ends at step 109.

25 If the user requests a change at step 108 then communication shown in box 110 between the base station and mobile is maintained for the information exchange in step

111, the nature of which will depend on the capabilities of both mobile and network. At least three conditions can affect the nature of this information exchange.

5 Firstly, the mobile may not be able to support the required software. Where the mobile is not able to support the required software, no communication channel is available to the mobile from the existing network resources and use of the mobile within the region will therefore not be possible.

10 Secondly, the required software may be stored already in the mobile's memory. In this situation there is no need to download a software module but the allocated bootstrap channel connection is maintained for further operations as described.

15 Thirdly, the software module required to support a different type of communication or user application may need to be downloaded from the base station. Where the download of a software module is required, initially a selection script is downloaded to the mobile followed by  
20 downloading and installation of the required software.

In step 112 shown in FIG. 1, it is checked whether radio scheme/protocol is loaded in the memory of the mobile (i.e., terminal) or not, thereby discriminating the above second case from the third case. When the download of the  
25 required software into the mobile has been completed the processing goes to step 115. If the download of the required software has not been completed at step 112, the

selection script is downloaded at step 113 as described above and the required software is downloaded over-the-air and installed at step 114. Then, the mobile is set up at step 115.

5       After the completion of installation of the required software to the mobile at step 116, the mobile signals to the network the achievement of correct reconfiguration. On receipt of the "correct reconfiguration" signal from the mobile details of the mobile identity and its present  
10       configuration are entered on the network database (to license the product for instance). Then the network database is updated at step 117.

With reference to FIG. 2, the logical structure of the bootstrap channel 1 will include two logical sub-  
15       channels: a download channel 2 and a signaling control channel (S\_CH) 3. The signaling control channel 3 assists in the reduction of errors in transmission so as to allow correct software download.

In the above example, the first channel, the pilot  
20       channel, is standardized and the mobile must be configured to support the radio interface for the pilot channel. The second (bootstrap) channel may be subject to local definition through logical mapping on a local transmission mode e.g. GSM, DECT (digital European cordless telephone)  
25       and the mobile is not initially configured to support the radio interface for the bootstrap channel.



An example of a method of re-programming providing greater flexibility will now be given. This example is modification of the example shown in FIG. 1. In this example the mobile is configured to support the radio interfaces for both the first, dedicated relatively small bandwidth (pilot) channel and the second relatively large bandwidth (bootstrap) channel. That is to say that when the mobile is switched on in most and preferably all regions, the network can communicate with the mobile via both pilot and bootstrap channels.

In order for the mobile always to have the appropriate radio interface for the bootstrap channel then this channel would need also to be standardized (in addition to the pilot channel). The parameters of the bootstrap channels provided in different regions may have local variations in terms of e.g. allocated frequency, data rate and available user applications.

With reference to FIG. 3 which is a flow diagram of the reconfiguration process for this example, the mobile when switched on at step 101 reads the pilot channel broadcast. The allocated frequency and radio resource parameters for the bootstrap channel contained in the pilot channel broadcast are processed at step 118 and any required logical mapping effected at step 106. After processing the received information, the mobile communicates with the base station through the bootstrap channel in box 110.

The condition likely to be experienced in the previous example whereby the mobile is not able to support the required software and no communication channel is available to the mobile from the existing network resources does not apply in this arrangement. The communication via the bootstrap channel allows the request for and supply of the software module necessary to establish communication with the network. The transfer to the bootstrap channel does not depend on the existing configuration of the mobile since the bootstrap channel is standardized in this example and the mobile is equipped to interface, via the pilot channel, with the bootstrap channel.

The services and structure offered by the bootstrap channel are common for both of the above examples, however, the requirements on the terminals and networks differ.

The bootstrap channel will provide the following services by means of over-the-air (OTA) reconfiguration:

(1) capability exchange : the terminal provides some information to the network on its current configuration and capabilities.

(2) module selection : at this stage the user specifies the software that his terminal requires to download. This operation could be compared to an installation script.

(3) data download : transfer of the data. In some cases software code will have to be downloaded whilst in other cases the software may already be implemented in the

mobile. In the latter case, a set-up mechanism would be sufficient to initiate the reconfiguration.

Once the mobile and the base station are synchronized on the bootstrap channel, information exchange can begin.

5        It is to be understood that variations and modifications of the over-the-air re-programming method disclosed herein will be evident to those skilled in the art. It is intended that all such modifications and variations be included within the scope of the appended  
10        claims.

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